BRICOLAGE BURNERS

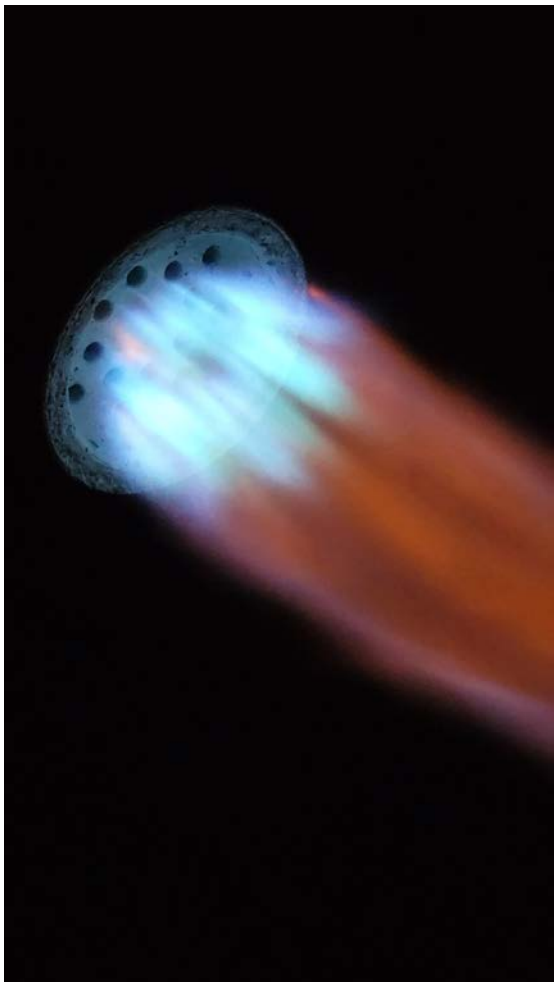
DIY Guide

Build your own high performance burner nozzle using accessible tools and techniques.

--- No metal fabrication or welding required ---

--- Open Source --- Right to Repair ---

Full Video: youtube.com/@BricolageBurners



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Process Outline

1. Print the mold kit, or order it online
2. Prepare the metal hardware
3. Casting
4. PLA burn-out / Refractory curing
5. Cleanup
6. Installation

Print the Mold Kit

Download the respective files for the Bricolage Burner model you want. (See Page 6)
File Source: https://archive.org/details/@bricolage_burners

Or search “bricolage burners” on Thingiverse, Printables, MyMiniFactory, Cults3d, YouMagine, etc.

****** Before printing, select the right parts ******

You will be using some metal hardware to build these burners. One of these metal parts is a “floor flange” that can be found at most hardware stores. There are two different 3D printed “cap” parts in the 3D printed mold kit that are associated with two different common types of floor flanges. Select the right “cap” to make sure it will fit the specific flange you have.

“STZ Cap” is designed to fit flanges manufactured by STZ Industries, sold under the brand “STZ” in most stores, or “Reliabilt” at Lowe’s stores. They look like this.

“Southland Cap” is designed to fit flanges manufactured by BK Products, sold under the brand “Southland” at Home Depot, also confusingly sold as “Reliabilt” at Lowe’s stores. They look like this.

The rest of the printed parts in the mold kit have been designed to be universal for most floor flanges.

See Page 6 for list of Hardware

<u>Option 1</u> - Print the parts yourself, or ask a friend:

This mold kit was designed specifically to be easily and efficiently printed with the most accessible types of 3D printers available today. If you can't print these yourself, you may have either a friend, family member, co-worker, or neighbor that tinkers with 3D printing. There are also many makerspaces and libraries in many major cities that have 3D printers and people who know how to use them. Make sure to print with PLA plastic. It's the most common, standard 3D printing plastic.

<u>Option 2</u> - Hire a local printer:

There are many people on Facebook Marketplace with a 3D printing side-hustle who would be more than happy to print these parts for you. Make sure they print with PLA plastic. It's the most common, standard 3D printing plastic.

<u>Option 3</u> - Order prints online:

If you'd rather order the parts online, there are many websites like craftcloud3d.com where you can upload these files and have them print and ship the parts to you. Again, be sure to select PLA as the material type.

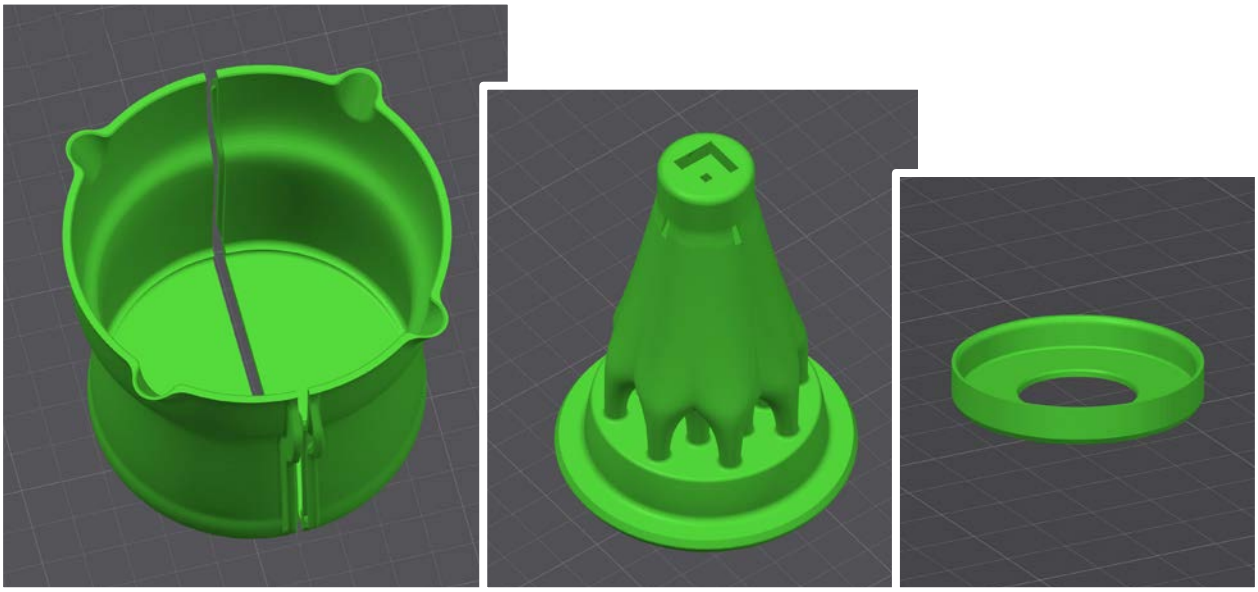
Slicer (Print) Settings:

Whether you are printing these yourself, or outsourcing the printing, here are some suggested print settings for this mold kit (using 0.4mm printer nozzle)...

Part Name:	***Shell (x2)***	***Core***	***Cap (STZ/Southland)***
Material Type:	PLA	PLA	PLA
Layer Height:	0.2mm - 0.28mm	0.2mm	0.2mm
Wall Count:	3	2	3
Infill:	10%	10%	100% (Solid)
Bed Adhesion:	Mouse Ears	None	None
Supports:	None	None	None

Print Orientation:

Arrange your parts as shown below for best results. (Arranging the "Shell" parts like this will give you the best fit, whether your printer is highly calibrated or not.)

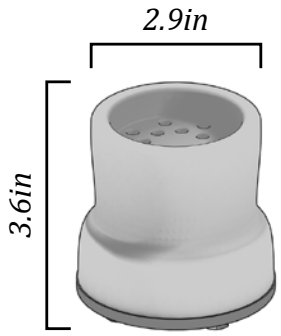


Buy the Hardware

Purchase hardware specific to the Bricolage Burner model you plan to build:

Bricolage Burner Models:

***BB-075* (v1.0) -** *For **¾ inch** threaded Venturi systems*



Hardware Needed:
(1x) ¾ in Black Malleable Iron Floor Flange Fitting
(4x) ¼ in-20 x 1 in Hex Bolts (Stainless Steel, preferred)
(4x) ¼ in-20 Hex Nuts (Stainless Steel, preferred)
(4x) ¼ in Flat Washers (Stainless Steel, preferred)
(4x) Small Binder Clips

Recommended compatible venturi burners:
- ***Ransome V075*** *(burnerdepot.com)*
- ***Lsmiitth "Lava Furnace Venturi Forge Burner"*** *(eBay, Walmart, Amazon, etc.)*

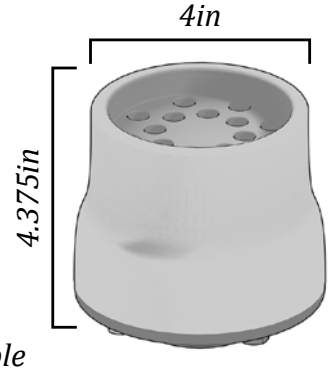
***BB-125* (v1.0)** *- For **1 ¼ inch** threaded Venturi systems*

*(Ideal replacement for **Gaco MR-100** venturi for ceramicists)*

(In Development. Coming Soon.)

Recommended compatible venturi burners:
- ***Ransome V125*** *(burnerdepot.com)*

***BB-150* (v1.0)** *- For **1 ½ inch** Forced Air / threaded Venturi systems*



Hardware Needed:
(1x) 1-½ in Black Malleable Iron Floor Flange Fitting
(4x) 5/16 in-18 x 1-1/2 in Hex Bolts (Stainless Steel, preferred)
(4x) 5/16 in-18 Hex Nuts (Stainless Steel, preferred)
(4x) 5/16 in Flat Washers (Stainless Steel, preferred)
(4x) Small Binder Clips

**** Designed for **Forced Air burner systems** (DIY), but is also compatible with **Ransome V150** venturi burner (burnerdepot.com)*

Prepare and Assemble the Hardware

CAUTION: *If you're only able to find the "galvanized" version of these hardware parts (as opposed to "black malleable iron" or stainless steel), you should remove the galvanization before proceeding. This galvanization is a layer of zinc that's bonded to the iron/steel that will release toxic fumes if exposed to heat.*

To remove this zinc, clean the parts with soap and water, then leave them submerged in vinegar for 24 hours outdoors, since this will release toxic fumes. Then, wearing rubber gloves, remove the parts and scrub them clean with a metal wire brush and soap and water. After drying, these parts may develop a light layer of rust, which is fine.

Assembling the Hardware:

1. Wash your hands with soap and water, then scrub all metal parts with dish soap and water and an old toothbrush. Rise them clean and wipe them dry. This will ensure that the parts can be reliably glued together.

2. Attach the correct plastic “cap” part onto your flange, then apply hot glue to the edges on four sides to temporarily bond it to the flange, as shown in the photo. If your printer is calibrated well, the cap should fit snugly but not require tremendous pressure to install onto the flange.

3. Once the hot glue has hardened, place this assembly onto the 3D printed “core” part.

4. Apply a ring of super glue (cyanoacrylate gule) around one of the bolt holes on the flange, then place a flat washer onto that space. Apply more super glue on top of the washer and insert the hex bolt. Make sure the bolt hangs down as straight as possible. Repeat this for the other 3 washers and bolts. The super glue temporarily keeps the hardware assembly in place when vibrating the mold during the casting process later.

5. Once the super glue has hardened, flip the assembly over, and attach one of the hex nuts to the end of one of the hex bolts, so that it is flush with the end of the bolt, and preferably in the orientation shown in the photo. Apply 2 drops of super glue to this connection. Repeat for the other 3 nuts.

Casting

***Prepare the Mold*:**

Using a small paint brush, fill the threads of the floor flange with petroleum jelly. This will prevent the castable refractory from clogging them later. Apply a thin, even layer of petroleum jelly to all inner surfaces of the two plastic "Shell" mold parts. Don't forget the edges where these two parts meet together. This will prevent water from leaking out of the mold during the casting and hardening stage. It's not necessary to cover the "core" part with jelly, since this core will have to be burned out of the casting later. Assemble the core and shell parts together and attach four binder clips to secure this assembly.

***The Recipe*:**

**** The following weights and measurements are specific to **"Mizzou Castable Plus"** refractory cement, since this the only kind that I have available locally. Most people recommend **"Kast-O-Lite 30 Li Plus"**, instead. I've included an untested recipe below as my best estimate for Kast-O-Lite, based on the manufacturer's recommendations.*

If you plan to make only one or two burners, you can find Kast-O-Lite, Mizzou, and other alternatives in small quantities, like in 5 or 10lb bags on eBay, Etsy, Amazon, etc. If you plan on making more, you can sometimes find castable refractory cements in 50lb or 90lb bags for much cheaper at clay artist supply stores that sell clay and glazes, etc., but you might also find it at firebrick oven or fireplace material suppliers near you. If you're really lucky, you may live near a Harbison Walker distributor.

Basically, you mix these refractory cements with water just like regular cement, except these can withstand continuous use at temperatures up to 3000℉ (1650℃). The recommended amount of water for Mizzou is 9%-11% water by weight. Kast-O-Lite recommends 18%, exactly. For example, with 100g of Mizzou, you use 11g of water if you are using 11% water by weight. With Kast-O-Lite, you would use 18g of water.

With Mizzou, a mix with 9% water will produce the strongest casting. An 11% mix may produce a weaker casting, but I find that it casts more easily, and works just fine in the finished burner.

**** Nerd Tip: When using 11% water, Mizzou uses roughly 37.84g dry material per cubic inch. For example, a cast object with a volume of 10in^3 will require about 378.4g of dry Mizzou.*

Mizzou Castable Plus *- Recommended Weights:*
(These weights are estimates. You may want to mix a little more, just in case. Decide how much dry material you want to use. Multiply that by 0.11 and that's the amount of water you use.)

Burner Model	Casting Volume	Dry Refractory (Mizzou)	Water
BB-075 *(v1.0)*	15.6 in³	591 g	65 g
BB-150 *(v1.0)*	36 in³	1363 g	150 g

**Kast-O-Lite recommends about 23.58g dry material per cubic inch, plus 18% water by weight...*

Kast-O-Lite 30 Li Plus *- Recommended Weights (untested):*
(These weights are estimates. You may want to mix a little more, just in case. Decide how much dry material you want to use. Multiply that by 0.18 and that's the amount of water you use.)

Burner Model	Casting Volume	Dry Refractory (Kast-O-Lite)	Water
BB-075 *(v1.0)*	15.6 in³	367.9 g	66.2 g
BB-150 *(v1.0)*	36 in³	848.9 g	152.8 g

Casting:

1. Get your vibrating tool ready. I recommend a “sawzall” (reciprocating saw) with its blade removed, but an orbital sander will also work.

2. Put on rubber gloves and a respirator or dust mask. In two separate containers, weigh the dry refractory and the water.

3. Add the refractory to the water, and mix by hand for about 3 minutes, or until thoroughly mixed. There’s no need to rush this step. This cement will not begin to harden for at least an hour. With Mizzou, at least, the mixture will seem like it’s too thick to fill the mold. ***Do not add more water.*** It will compact itself together and behave more like a liquid when you start vibrating the mold.

4. Put a small handful of the mixture into the mold, and vibrate the side of the mold until the mixture settles level into the bottom of the mold. As you vibrate, you should see some small air bubbles rising and popping on the top surface of the mixture. If your vibrating tool has a variable speed, experiment to find a speed that causes the mixture behave most like a liquid and pops the most bubbles. Vibrate along all sides of the mold until there are not so many bubbles popping any more. (Be careful to not over-vibrate the mold. This can cause too much of the water to separate from the refractory cement, causing an uneven and weak casting. If your refractory also has aggregate (little pebbles) in it, over-vibrating can cause the aggregate to settle to the bottom of the mold, creating impurities in the front face of your burner.) Repeat this step until the mold is full.

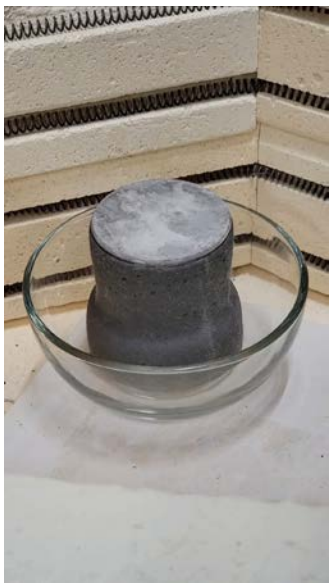
5. Place your metal hardware assembly onto the mold, and start vibrating the mold, while guiding the assembly into place as it sinks into the refractory cement. You may want to press down onto the assembly at first. When the assembly seems like its just a few millimeters from reaching its full depth, I found that the best thing to do is to stop vibrating the mold, and twist the assembly back and forth while pressing it down to get it to sit fully flush onto the “core” printed part. Finish by vibrating the mold a bit more, then wipe any excess cement from the top of the mold.

6. Place the mold into a plastic bag, and loosely tie the bag, leaving a small opening. You don’t want to fully seal the bag, because steam can build up inside. Leave this for 16-24 hours in a room above 60℉. For best results, cure at 90-110℉. Do not let the casting freeze at this stage.

7. Remove the mold from the bag, remove the binder clips, and use a flat head screwdriver or utility knife blade to wedge apart the two mold shell halves. Use a utility knife blade to scrape away the flashing on the side of the burner. Use a steel file to scrape and smooth the excess refractory near the metal flange.

Burn-Out/Curing

The burner now needs its plastic core burned out, and the refractory to be dried and cured/fired. The best way to do this is in a single firing in an electric kiln with a digital controller. If you don't have access to one, I would suggest reaching out to your local ceramic artists/studios, glass fusing or glassblowing artists/studios, or metalsmith artists/studios, and ask them if they could do this firing for you.



If you're using an electric kiln, place the burner onto a cheap glass plate or bowl, and place it onto a primed kiln shelf inside the kiln (the shelf is important, in case the kiln accidentally fires above 1000℉ and melts the glass). Make sure the kiln is well ventilated, because this firing will produce some very unpleasant fumes/smoke once the super glue and plastic start to vaporize/burn. I always do these firings over night, when no one is in the building. (Skip the next paragraph, to the firing schedule below.)

As a last resort, you could do this firing manually, but keep in mind that you're very likely to accidentally move through the heating process too quickly, which will cause hairline cracks in the burner. Basically, you would be attempting to manually control the kiln firing schedule shown below. Use a toaster oven (that you don't plan to use for food anymore) to get the burner through the heating steps up to as hot as the oven can reach, then finish the firing schedule in an electric or gas foundry/ burn-out kiln while using a pyrometer to monitor the temperature. ***At temperatures above 300℉ or 400℉, there will be some very unpleasant fumes/smoke once the super glue and PLA plastic start to vaporize/burn, so do this firing outdoors away from people and wear a cartridge respirator.

Firing Schedule:

Step #	Rate (ºF/Hr)	Temperature (ºF)	Hold/Soak Time (Hr)
1	75	250	1
2	75	500	1
3	75	1000	1

In basic terms, this means the burner should be heated at a rate of 75°F per hour, from room temperature to 250°F, then held at 250°F for 1 hour. Then, heated 75°F/Hr up to 500°F, and held at 500°F for 1 hour. Then, heated 75°F/Hr up to 1000°F, and held at 1000°F for 1 hour. After this, keep the burner inside the kiln and let it naturally cool inside until it's back to room temperature.

Cleanup

Once the kiln has returned to room temperature, all that's left to do is clean the PLA ashes from the burner

1. Wearing a cartridge respirator / dust mask, use a (dry) plastic bristle brush to gently scrub the ashes off the front face of the burner.

2. Use a (dry) plastic straw/pipe cleaning brush to gently scrub the ashes from each port of the burner.

3. Use a metal wire brush to scrub the threads of the flange. If there are still some little pieces of flashing from where the air vents were near the flange threads, break those off.

4. Use compressed air to blow the remaining ashes out of the burner.

Installation

Install the burner so that it is not deep inside the forge/kiln/furnace heating chamber. Do not cover the sides of the burner with insulation, like Kaowool/ceramic fiber. You should install the burner so that only the front of it is exposed to the most intense heat of the chamber, and so that there is space around the sides of the burner.

This allows for gradual heat transfer around the burner, reducing the chance of thermal shock, which can lead to premature cracking and degredation of the burner. If you're using a venturi, you will also benefit by allowing secondary air to enter the chamber this way, allowing for more complete combustion of fuel.

Direct Flow Orientation

Compact Orientation